Ruataniwha Water Storage Scheme

Regional Economic Impacts and Financial Cost Benefit Analysis of the Proposed Ruataniwha Water Storage Scheme

Report prepared by
Butcher Partners Ltd for

Hawke's Bay Regional Investment Company Limited

May 2013

KEY RESULTS

Economic Impact Assessment

Regional GDP will increase by a one off $350 million as a result of both on-farm and off-farm investment associated with the on-farm development and construction phases of the Scheme. Associated with that will be an extra $230 million of household income and 4,000 job-years of work. These impacts will be spread over 12 years, but 80 % will occur in the first five years.

Regional GDP will increase as farms convert to irrigation, and once 100 % of them are converted regional GDP on farms and in industries that directly or indirectly support farms will increase by $127 million per year. Associated with this increase will be an additional $52 million per year of household income and 1,160 Full Time Equivalent jobs.

There will be an increase in processing of vegetables, grapes, other fruit and possibly dairy, although there will be a decline in meat processing with the conversion of so much sheep and beef to dairying, dairy support and intensive process crops. While there is considerable uncertainty about the level of processing that will occur in the region, total combined increase in activity in the farming, processing and supporting industries could raise regional GDP by approximately $235 million per year including an additional $110 million per year in household income. A total of 2,250 extra on-going jobs will be created in the region

Economic Benefits- Cost Benefit Analysis

There will be a net economic benefit to farmers (at the assumed water charges) equivalent to $46 million per year once the the Ruataniwha Water Storage Scheme (the Scheme) is fully implemented, and a benefit to the Scheme of $19 million per year in water charges. However, this additional income has to be used to cover the Scheme operating costs and the up-front capital and interest of on-farm and off-farm investment. Depending on the real interest rate and the life time of the Scheme, the irrigation supplier and farmers will be better off over the entire Scheme life by the equivalent of between $0.6 million and $21 million per year, which have Net Present Values (NPV) of $7 million and $408 million respectively. This NPV benefit might be termed the “super profit”, which is the profit over and above the normal returns to labour and capital invested in the Scheme. The huge variation in benefits reflects the significance of the choice of Scheme lifetime and interest rate assumptions, particularly in long-lived projects. It is our view that the $7 million NPV figure is useful only inasmuch as it can be used by Treasury to provide a funding priority ranking for this Scheme against other infrastructure projects with similar lifetimes and project assumptions. We believe that from a community and farmer perspective the figures of $21 million per year and a NPV of $408 million are more relevant.

The wider community is also expected to benefit from the increase in household income and employment discussed above, but the scale of this benefit depends on the ways in which labour and capital would have been employed in the absence of the Scheme. If the Scheme displaces other projects which are just as good, then there is no particular benefit from the Scheme because net employment and income will not have increased. It will simply have been switched between industries. It is our view that this Scheme will significantly increase regional income and employment above what it would otherwise be, but we note that not everyone shares this view. There is no agreed factor to convert impacts to benefits.

We can not say whether the Scheme will have a net benefit from the widest societal perspective, which takes into account environmental and other non-market values such as recreation which are affected by the state of the river and levels of water abstraction. That widest perspective is a matter beyond the scope of economics. What we have done is provide decision makers with information to inform their weighing up of the wide range of costs and benefits.

Councils in Hawke's Bay will benefit by an estimated $2.4 million per year increase in rates, although this is not a pure benefit since they will also have to pay for an increased range of services as a result of the increase in population and economic activity generally. Councils are also likely to enjoy an increase in returns from the Port which could be of the order of $1.3 million per year. Councils may use their net increase in income to either increase the range of services they provide to the community, or reduce the average rate burden for all ratepayers.

1. Executive Summary

A. Potential Scheme Effects

1. The assessment of Regional Economic Effects and net national benefits in this report is based on the proposed Ruataniwha Water Storage Scheme (the Scheme) as described in the report entitled Ruataniwha Water Storage Scheme: Project Description, Tonkin & Taylor (May 2013), referred to in this report as the Project Description (PD). It also applies information supplied by Macfarlane Rural Business Ltd (MRBL) as to 'before and after' Scheme land irrigation use scenarios, along with on farm conversion costs and returns.

2. Applying the post Scheme land use irrigation scenario adopted by MRBL, the proposed Scheme will irrigate 19,000 Ha of dry land[1] with potential to provide increased reliability of irrigation on a further 6,000 Ha of currently irrigated land. The Scheme is estimated by Tonkin and Taylor (T&T) to cost $246[2] million for an in-river dam, a headrace which is a mix of piped and open channel, and then piped distribution beyond the headrace, although farms will generally not get water at sufficient pressure for irrigating.

3. On-farm investment will depend on the land uses on the newly irrigated land, but base case estimates[3] by MRBLare that the farmer investment will cost $356 million, including $247 million for physical investment on-farm, $16 million for livestock, and $93 million for dairy company shares and working capital.

B Assessment Undertaken

4. The scope of this assessment was the net national benefit from a commercial perspective only, and the net regional economic impacts in terms of regional GDP, employment and household income. These arose from:
   - Change in land use on irrigated land and changes in farming practices;
   - Industry support effects arising from the expansion of output in those industries which directly or indirectly provide supporting goods and services to agriculture;
   - Changes in output of processing industries including for meat, milk, grapes and vegetables; and
   - Effects on Napier Port.

5. The benefits and impacts are based on an analysis of likely irrigated areas, irrigated land use mix, and farm financial performance as estimated by MRBL.

6. There is considerable uncertainty as to the exact mix of land uses on future irrigated land, the level of processing of production from the irrigated farms, and the

---

1 This is a conservative assumption to ensure the economic benefits are not overstated, and assumes 6,000 Ha of Scheme irrigation capacity is used to irrigate land already irrigated by less reliable surfacewater and ground water takes, rather than being applied to irrigate additional land.

2 Includes $7 million of mitigation costs over the Scheme lifetime.

3 Adjusted to removed increases in raw land value, and allowing for some existing plant being redundant or unsuited to new farming practices .

proportion of processing which will take place in the region. The figures given here are realistic assessments of what is likely to occur, but actual outcome could be higher or lower than this.

7. The cost benefit analysis ignores any environmental effects which arise from the land use changes. The cost benefit analysis also ignores any benefits arising purely from increased employment opportunities, or from increased value added in industries other than farming. This is a conservative position, but reflects the possibility that in an efficient economy the capital and labour would otherwise be used elsewhere in the economy and the expansion of irrigation does not actually provide any additional employment.

8. The analysis ignores any benefits arising from additional irrigation water that will on occasion be available[4]. Nor has any assessment been made of the potential for using some water to supplement water available to other downstream users. While this water may have greater value in use downstream, its use will reduce either irrigable area or reliability in the existing command area, the additional value has been neither estimated nor proved.

9. The economic impact analysis shows the potential scale of impacts, provided there are spare resources of labour and capital available. We have not undertaken a regional general equilibrium analysis.

C Results of Assessments

C1 Economic Benefits

10. The Net Present Value of the Scheme is estimated to be $7 million at an 8%[5] discount rate. In broad terms this benefit is equivalent to the Scheme participants[6] receiving a 35 year stream of benefits of $0.6 million / year (after all the costs of additional on-farm and off-farm capital have been met). Reducing the discount rate to 5 %[7] increases the NPV to $225 million, equivalent to $14 million per year in net benefits to farmers and the irrigation supplier.

11. The base line 35 year Scheme life corresponds to the proposed water right term and 8 % is the recommended Treasury discount rate. Using different assumptions of a 70 year Scheme life and a 5 % discount rate, which arguably is more consistent with farmers' investment decisions elsewhere and with a societal concern about long term impacts and the likely minimum life of the irrigation infrastructure, the benefit has a NPV of $408 million, which is equivalent to $21 million per year. It is our view that from a community and farmer perspective these latter figures are more relevant. This benefit can be thought of as a "super profit"; a return above what the resources used in

---

4 See PD section 3.2.2.6 which refers to secondary irrigation water of up to 28 million m3 per year. Given the uncertainty surrounding the availability and reliability of this water, and its potential use for purposes other than agriculture, no assessment has been made of the benefits or regional impacts of this water.

5 At an 8 % discount rate, the currently recommended Treasury benchmark

6 Farmers and the irrigation supplier.

7 There are strong arguments in favour of a lower discount rate, of the order of 3 – 5%, This reflects a "Social Rate of Time Preference", and is also consistent with observable farmer decisions regarding land purchase prices and other on-farm investments. See NZIER *Insight* no. 32/2011 for a discussion of the issues.

this Scheme would normally earn elsewhere and accrues to farmers and the irrigation supplier.

12. The above assessments of benefit follow a standard CBA assumption that apart from this "super profit", there is no net benefit from the Scheme. The extra production both on and off-farm requires the use of resources (land, labour and capital) which could otherwise have been used elsewhere in the economy to achieve the same community economic and social impacts and benefits as they will in these projects. Hence there is no particular additional benefit from investing in the Scheme.

13. This assumption is not accepted by many in the community who are of the view that this Scheme will provide more jobs and income than would occur in the absence of the Scheme, and that accordingly the community is better off and there is a net benefit. The magnitude of the benefit will likely be debated with opinions ranging upwards from zero.

14. Against these benefits need to be weighed up any wider community social, recreational and environmental outcomes associated with the change in water use and river state.

Summary Table 1 Net Present Value of Ruataniwha Scheme

Values at full development	Financial Value	NPV 8 % over 35 years ($m)	NPV 5 % over 35 years
Water Storage Capex	- $246 m	- 203	-217
Farm Investment Capex	- $356 m	- 229	-268
Electricity Generation	$1.9 m / yr	21	30
Scheme Operating Costs	- $2.5m / yr	-29	-40
Revenue from Water Charges*	$19 m / yr	136	218
Increased Farm Profit**	$65 m / yr	308	501
Net Benefit		+ 7	+225

* Assumes charges of $0.20 / m3

** After adding back water charges, which are assumed to be sufficient to cover capital and operating costs.

15. The results assume all water will be taken up within 8 years of the Scheme becoming operative, and also rely on the farm budgets presented by MRBL. The results also assume that the Scheme will provide water for only the 35 years covered by the water consent, and hence implicitly assume that infrastructure at this point has no residual value. Changing this restrictive assumption to a 70 year or 100 year lifetime of the Scheme increases the Scheme NPV as is shown in Summary Table 2 below. The net financial benefit of the Scheme at a 5 % discount rate and a 70 year life is $408 million, which is equivalent to $21 million per year.

Summary Table 2. Net Present Value of Scheme ($m) under varying assumptions

Scheme Life	8 % discount rate		5 % discount rate	
	NPV ($m)	Equivalent Annual Value ($m/yr)	NPV ($m)	Equivalent Annual Value ($m/yr)
35 years	7	0.6	225	14
70 years	54	4.5	408	21
100 years	57	4.6	439	22

16. The commercial benefits arising from expanding the area in orchards and vineyards, as measured by the NPV, are negative at a discount rate of 8 %. This is consistent with the MRBL report showing marginal accounting rates of return of 9.5 % for orchards and 7.5 % for vineyards[8]. While these rates roughly straddle the discount rate, implying a close to zero NPV for these activities, the accounting rate of return does not reflect the time lag between investment and full production, which is four years for vineyards and six years for orchard. Hence the IRR for orchards and vineyards is less than the discount rate and the NPV is negative.

17. There is a clear net commercial benefit to farmers and the irrigation supplier from irrigation over and above the opportunity cost of capital and labour employed in increased production, and this benefit is what the Scheme NPV measures. The Net Present Value calculation ignores any net recreational, environmental and community costs and benefits of irrigation. The recreational and environmental values will be discussed by others with expertise in these areas, but the impacts on regional employment and income are outlined in this report.

18. We anticipate that people in other sectors who experience an increase in economic activity will also perceive themselves to be receiving a benefit. The formal cost benefit analysis framework does not recognise this latter benefit because of the framework's restrictive assumptions regarding price equalling opportunity cost in these other sectors[9]. It is for this reason that we show in the following sections the increase in employment, regional GDP and regional household income. Decision makers can take these impacts into consideration when deciding whether the Scheme has larger benefits than costs when viewed from the widest societal perspective.

C2. Economic Impacts

19. The economic impacts arising from the Scheme have two components. The first is the impact of construction on and off-farm. This is a one-off impact, and for this reason impacts are expressed as $million (rather than $million per year) and job-years (as opposed to on-going jobs). The second component of economic impact is the on-going effect of increased farm production. This generates impacts including:
    a. on-farm,

[8] MRBL 2012, p44. Assuming conversion from finishing farms

[9] In simple terms, formal cost benefit analysis assumes that unless there is reason to assume otherwise, price equals opportunity cost, which is the benefit foregone in the next best possible use.

b. in all the industries that support farming production and farm household spending (e.g. agricultural contractors, stock and station agents, rural transport, shops and service providers); and
c. In processing industries such as meat, dairy and vegetable processing, and in all the industries that support the processing industries and the household spending that flows from them.

20. Economic impacts are generally reported in terms of changes to output (sales), value added[10] (sometimes referred to as regional income or regional GDP), household income (which is a component of value added) and employment. The impacts are split up into the direct effects, which in this case are the direct changes in output, employment and income on-farm, and the multiplier effects, sometimes referred to as the indirect and induced effects, or the industry-support effects.

One-Off Construction Impacts

21. The investment of $602 million leads to economic impacts during construction including an increase in regional value added of $350 million, including household income of $230 million, and an additional 4,000 job-years of work. This economic impact will be focussed on the first four years, when all the dam construction and the first 56 per cent of pastoral on-farm investment are assumed to take place. The balance will be spread over the remaining eight years of the investment programme until land development is completed.

Summary Table 3 Regional Economic Impacts of Ruataniwha Scheme – Construction-related only (One-off effects spread over 12 years)

	Output ($m)	Jobs (job-years)	Value Added ($m)	Hhold Income ($m)
Direct Impacts	602	na	na	na
Total Impacts	1,100	4,000	350	230

On-Going Impacts Arising from Increased Farm Production

22. The Scheme will increase farm-gate output by $160 million per year. This increase will be accompanied by an increase in direct value added[11] on farm of $70 million per year, including $25 million per year of earned[12] household income. There will be an increase of 630 jobs on farm, with 500 of those occurring in vineyards and orchards (see upper section of Summary Table 4).

23. Multiplier effects arise as a result of the expansion of economic activity in supporting industries. The combination of direct impacts on farm and multiplier[13] effects in the farm-support industries gives a total increase in regional value added of $127 million per year, of which earned household income will be $52 million per year. The additional 530 jobs created off-farm give a total increase of 1,160 jobs in the region (see lower section of Summary Table 4).

---

10 In accounting terms this is equivalent to EBITDA.

11 Value added is the return to labour and capital. It is the equivalent concept to Gross Domestic Product. In accounting terms it can be seen as EBITDA + wages & salaries, or as gross output less purchases of inputs (other than capital and labour).

12 Wages and salaries, plus self-employed income. Excludes any dividends from increased profits

13 Sometimes called indirect and induced effects.

Summary Table 4 Regional Economic Impacts of Ruataniwha Scheme – Farm and Farm-Support Only at Full Development

Increase	Output ($m / yr)	Jobs (FTEs)	Value Added ($m / yr)	Hhold Income ($m/yr)
Pastoral and arable farming direct	107	130	40	8
Orchards and Vineyards (or similar)	53	500	30	17
Sub-Total – Farming	**160**	**630**	**70**	**25**
Farm support effects (multiplier effects)	120	530	56	27
Total Farming and Farm Support	**280**	**1,160**	**127**	**52**

24. About 55 % of these farm and farm-support regional employment and value added impacts occur on farm. There are also significant effects on agricultural contracting, wholesale and retail trade, transport and communications, and services (including local authorities who get an estimated $2.4 million per year extra in rates income).

25. About 80% of direct on-farm employment, 40% of direct value added and 70% of direct household income arises from conversion to either viticulture or orchards. If there is no expansion of either of these activities[14], total value added in the region would increase by only $77 million per year (rather than $127 million) and total employment would increase by only 510 jobs (rather than 1,160 jobs). As described earlier, investment in these activities is by no means certain, with a commercial return (IRR basis) being less than 8 %.

On-going Impacts Arising from Increased Processing

26. Additional processing of vegetables and grapes, slightly offset by a decline in processing of meat, could significantly increase the regional economic impacts. We estimate that if all the extra processing of these items was done within the region, then there could be additional economic impacts of 980 jobs and $93 million/ year of value added, including $53 million per year of household income. There is no significant dairy factory in the region, but if one was developed and half the additional dairy production was processed within the region, then a further 110 jobs could be created along with value added of $14 million per year, including $7 million per year of household income (see Summary Table 2, lower section). We caution that there is enormous uncertainty associated with these numbers because of the uncertainty as to the mix of irrigated land uses, and hence the mix of product available for processing, and the location of any resultant change in processing activities (see lower section Summary Table 5).

27. As is shown in Summary table 5, the Scheme and the associated increase in farm production following full implementation, with all processing and related supporting industry activity factored in, could increase total regional GDP by $235 million per year or 4 %[15], including an additional $110 million per year in regional household income. The Scheme could increase total regional employment by 2,250 on-going jobs, or 3.5 % of current Hawke's Bay employment.

[14] Assuming that the land instead converted to mixed arable farming
[15] Latest available data for 2006-07

Summary Table 5 On-going Regional Economic Impacts of Additional Agricultural Production Arising from the Ruataniwha Scheme (at full development)

	Output ($m / yr)	Jobs (FTEs)	Value Added ($m / yr)	Hhold Income ($m/yr)
Farming and farm support	280	1,160	127	52
Processing and processing support (high uncertainty)	340	1,090	108	58
Potential Total Impacts per year	620	2,250	235	110
Potential NPV of impacts (8 % over 35 years)	2,500	17,800	1,800	910
(5 % over 70 years)	4,700	34,300	3,500	1,700

28. The impacts reported here should be seen as likely upper limits to the net impacts on the community[16] [17]. The estimates are based on an implicit assumption that there will be labour available to take up these jobs, and that the people taking them up will be either unemployed or out of the labour force in the absence of the irrigation, or will be migrants into the region from elsewhere. To the extent that the jobs are filled by people leaving existing jobs in the region and those jobs are not filled, the impacts will be lower than is estimated here.

Effects on the Port[18]

29. The additional product could lead to up to 9,000 additional full containers per year being shipped through Port Napier, which could increase port earnings by perhaps $1.3 million per year. The number of additional containers is significantly affected by the level of processing taking place in the region, and by shippers' decisions as to the best port to use given the schedules of the shipping lines at the time.

Farmer Affordability

30. MRBL believes that farmers look at accounting rates of return rather than more formal NPVs or IRRs. The available data suggests that conversion will be affordable from the farmers' perspective. The MRBL estimate of the accounting rates of return on marginal farm investment are 10 - 15 % for dairying, -6 % for finishing, 4 % for mixed arable, 30 % for intensive arable with crops for processing, and 65 % for mixed livestock and Dairy Support.

31. The benefit on farms will be derived from a number of sources:
    On the irrigated area:
    - An increase in production associated with irrigation of existing systems;

[16] For the assumed land uses. Different land use mixes will give different results.

[17] It has been assumed that owners of 6,000 Ha irrigated from current ground-water permits will surrender their water rights and take water from the Scheme. Hence the economic impacts are based on an additional 19,000 Ha irrigated. If these users do not transfer, then there will be a net increase of 25,000 Ha irrigated, and the benefits and economic impacts will be correspondingly greater. It is understood that the analysis of environment effects associated with such things as nitrate leaching is based on the assumption that there is a net increase of 25,000 Ha irrigated. Hence the assumptions differ, and either the economic impacts will be greater than is assessed here, or the negative environmental effects will be less than has been assessed.

[18] Economic impacts associated with increased port activity are included in the processing effects.

- A change in systems to higher intensity land uses such as dairying and cropping which are possible with more reliable irrigation;
- Reduced farming risk, which increases returns by enabling famers to move towards more risk-neutral behaviour, which generally has a higher average return than does a risk-averse management style.

On associated dry land:

- Ability to manage associated dryland areas better, given the increased flexibility which irrigation usually generates.

2. Background, Purpose of Report, Summary of Irrigation Scheme and Changes to Farm Production

Background

Recent Hawke's Bay Regional Council (HBRC) studies of the interlinked ground and surface water systems in the Ruataniwha Plains have indicated that the current rate of extraction, which is less than the consented takes, exceeds environmentally sustainable levels. This implies that there is no further available water to be consented and that in future limits on existing water take consents and minimum flow requirements will become more stringent.

Hawke's Bay is prone to drought. This reduces farm production directly and also makes farmers risk averse so that they operate their farm system not to maximise average profit but to limit potential losses in a drought year. The threat of drought also limits the land uses which are commercially viable.

Hawke's Bay Regional Investment Company Limited (HBRIC Ltd) has proposed an augmented irrigation scheme for the Ruataniwha Plains. Several alternative schemes were investigated, and HBRIC Ltd has selected on-river storage on the Makaroro River 1 km east of Makaroro Road. Tonkin & Taylor (May 2013) proposes an 83m high dam with storage capacity of 90 million m^3 [19], and a power station at the base of the dam capable of generating 26 GWh / year. MRBL estimates[20] that the total area able to be serviced by this storage is 25,000[21] Ha, including 6,000 Ha of currently irrigated land.

Purpose of this Report

The Scheme has proceeded to the resource consent stage and local and central government support, community support and the resource consent process all require some understanding of the likely regional economic impacts of irrigation. During the latter stages of the feasibility stage of the project in 2012, Hawke's Bay Regional Council (HBRC) asked Butcher Partners Ltd to undertake an assessment of the economic impacts of the Scheme as well as a Cost Benefit Analysis (CBA) from a commercial perspective. In 2013, at the request of HBRIC Ltd, the report was reviewed to ensure that it was consistent with the Project Description contained in the consent application. This is not a full CBA since it does not take account of the opportunity cost of water (i.e. its value in other uses), nor any other social, recreational or environmental costs or benefits associated with the Scheme. It is up to decision-makers (e.g. commissioners or the Environment Court) to weigh up the commercial benefits against the non-market intangible costs and benefits associated with social, recreational and environmental values. However, the economic impact analysis does provide information about the likely regional and district employment impacts, which are relevant in assessing these social and other impacts.

This study has used the unadjusted MRBL figures on irrigable areas and farm revenue and costs per Ha for the purposes of estimating economic impacts. There may be minor

---

19 Tonkin & Taylor 2013, section 3.1.5.

20 MacFarlane Rural Business Ltd, 2012

21 After recharge, river flows, evaporation, accumulation of 4 million m3 of dead storage over 22 years, and distribution losses of 4.8 million m3 from the canal network, there is 91 million m^3 available for irrigation. Quoted in MacFarlane Rural Business, *Ruataniwha Water Storage Project: Review of Farm Profitability. September 2012* section 6.12.

differences in some capital costs between this report and the MRBL report because of the way in which marginal capital costs per Ha were applied to the total area in changed land use. These do not materially affect the results or conclusions of this report.

Scheme Costs.
The construction cost for the dam, the associated power station, the distribution network and mitigation programmes has been estimated at $246 million[22]. Note that the head race is not piped, and although water is delivered from the head race via pipes, it is not delivered at sufficient pressure to avoid the need for on-farm pressurisation.

On-river dams were not initially considered because of perceived environmental effects and the potential difficulty in consenting. Nevertheless, these dams were found to be substantially more cost-effective than the off-river storage options considered. The environmental costs associated with the in-river storage are not considered further in this report, although it is noted that the positive NPV of the Scheme indicates that higher capital costs would not necessarily make the Scheme unaffordable to farmers.

Tonkin & Taylor (May 2013) note that there is considerable scope for optimisation of the distribution system in particular, including the approach for assimilating existing irrigation, facilitation of staged expansion of the distribution network and possibly providing pressure at take-off points to reduce on-farm pumping. The assumption is that the Scheme will deliver water with 92 % reliability – reflecting a model analysis of the 36 year historic flow record over which the scheme would have delivered the primary irrigation allocation in all but three years and noting that in those three years water unavailability was limited to periods late in the irrigation system. A detailed financial feasibility study would be required to establish if this is the optimal reliability.

Farm Budgets
MRBL has prepared a series of farm budgets for the situation "before irrigation" and 'after irrigation". The latter budgets allow for an impact on non-irrigated portions of partially irrigated farms, with this non-irrigated portion varying from 10 % of intensive arable farms to 20 % of less intensive mixed arable (both farm types on the plains) to 78 % of sheep and beef hill country farms with some irrigated land. Furthermore, they expect that there will be intensification of non-irrigated, but associated, land close to irrigated land. Such intensification occurs because demand from newly irrigated land makes different production profitable (e.g. dairy grazing is demanded by new dairy farms) and because associated infrastructure on adjacent newly irrigated land (e.g. cultivation, spraying, harvesting and storage infrastructure) will be available for use on dryland. MRBL long term price assumptions (2012 prices) include $6.50 / kg for milk solids, $4.25 / kg for manufacturing beef, $6.00 / kg for lamb and $4.00 / kg for wool. These are similar to the 8 year moving average (last four years actuals, current year estimate and next three years predictions) used in another recent study[23]. MRBL has also used $1,744 / tonne for grapes and $26 / carton for apples.

---

[22] *Pers comm* Grant Pechey, Hawkes Bay Regional Council. Includes $7 million of mitigation costs spread over 30 years.

[23] Butcher Partners Ltd and Agribusiness Group. *Irrigation Water in Ashburton District: Value at the Farm Gate.* 2012.

MRBL assumed that whereas dryland farmers are "average" performers, farmers on newly irrigated land will be in the top 20 % of producers. It is their view that this assumption is justified by experience, and that this level of performance is not only necessary to justify the costs of irrigation but occurs in practice.

During the peer review process[24] of the draft MRBL report, a reviewer suggested that "*the "average year" budgets for un-irrigated land will be difficult to achieve and probably do not adequately reflect the effects of the 1 in 10 year droughts that typify this locality*". This is not a criticism of the budgets so much as an acknowledgement of the difficulty of including random and uncertain events in average budgets. The implication of this is that the MRBL analysis may understate the profitability of irrigation, and that the NPV of benefits estimated in this report are understated.

The 2012 MRBL report does not have data on internal rates of return, but has accounting rates of return expressed as increase in net profit at full development divided by additional investment required.

In this report the IRR and NPV analysis uses all the MRBL on-farm capital costs and revenue value assumptions, but assumes that the off-farm capital expenditure occurs over the first four years of the Scheme. We also assume that the real price and productivity figures contained in the MRBL budgets are reasonable approximations of the average that will be achieved through the Scheme life.

Irrigation operating costs on-farm, primarily electricity costs, been included as electricity costs in the "Post-Storage" irrigated farm budgets. Off-farm costs have been included as a 20c / m^3 water charge for all the irrigated farm budgets. For the purposes of the NPV calculations in this report, the water charges have been added back to the farm profits to give a "profit before water charges", but all capital and operating costs of the Scheme have been included as project costs.

[24] Hugh Eaton, MRBL. Pers. comm.

3. Method

3.1 Benefit Cost Analysis

The CBA used a standard assessment framework using the best available estimates of on- and off-farm capital costs and benefits, with the latter being based on estimated increases in farm profits (after deducting all intermediate input costs, economic depreciation and wages of management – or equivalent owner-operator salary). The base case assessment assumes a 35 year Scheme life[25], uses a discount rate of 8 per cent[26], and assumes that on-farm investment to enable the irrigation of all pastoral land uses takes place over years 3 – 10[27] and that pastoral land reaches full productivity over three to four years while viticulture and orchards take respectively 3 and 5 years from planting to come up to full production[28]. The comparatively low rates of return for orchards and vineyards mean that if that land were used for some other purpose, the NPV results would increase, at least for the 8 % discount rate. Sensitivity testing assumes a discount rate of 5 per cent and a Scheme life time of 70 and 100 years.

It is assumed that the dams and distribution system are built over 4 years (years 0 – 3 of the Scheme time-line), even though total up-take of water by farmers is much slower, and takes ten years. The MRBL data on on-farm capital costs has been used except that their implicit increase in the value of land has been ignored[29] and a minor discrepancy in machinery costs has been corrected.

Note that a financial Cost Benefit analysis generally assumes perfect markets and hence does not ascribe any benefit to generating additional income or jobs per se. There is an implicit assumption that the wage paid to people is equivalent to the opportunity cost of their labour (it is assumed that their labour would otherwise be used in leisure or in some other productive activity), and hence generating a job has no net benefit. Capital also has an opportunity cost (it could have been used productively somewhere else), and additional income earned by capital in the wider community as a result of multiplier effects is assumed to be equivalent to the opportunity cost of capital, and hence also has no net benefit. A net benefit is presumed to exist only in the Scheme under investigation, and only to the extent that the returns to capital in this Scheme exceed the opportunity costs of capital in the Scheme.

Given that markets are arguably not perfect and that in many cases additional employment or returns to capital do generate a net benefit, then a financial cost benefit analysis may be seen as a very conservative estimate of the financial benefits of a project.

---

[25] Based on the fact that the water right will be for 35 years. If the right is not extended, then there will be no future irrigation and hence no residual value for the dam.

[26] Treasury –approved rate. See http://www.treasury.govt.nz/publications/guidance/planning/costbenefitanalysis There are strong arguments in favour of a lower discount rate, of the order of 3 – 5%. These lower rates reflect a "Social Rate of Time Preference", and are also consistent with observable farmer decisions regarding land purchase prices and other on-farm investments. See NZIER *Insight* no. 32/2011 for a discussion of the issues

[27] Based on survey undertaken by Castalia Strategic Advisers in August 2012. *Pers comm. G Pechey. HBRC*

[28] MRBL advise that output on grazing land is 85% of potential in year 1, 95 % in year 2 and 100 % in year 3 and beyond, while finishing land takes four years and mixed cropping and grazing takes 5 years to come to full productivity.

[29] Macfarlane *et* al August 2012. Tables 7.1.2 and 7.1.3 of the Macfarlane *et* al 2012 report have raw land values which differ by $9 million. Simon Harris (*pers. comm.)* has also suggested that upwards of $30 million of additional cost will be required to replace existing plant which MRBL has assumed is appropriate, but which in fact may be redundant or inappropriate for the new land uses. This is a debatable point and the figures used here have not been adjusted to reflect the Harris suggestion.

3.2 Economic Impact Analysis

Economic Impact analysis is used to estimate the total economic impacts at the regional level. Impacts are reported in terms of employment, regional GDP or value added[30], and earned household income, which is a component of value added.

The first step of the impact analysis was to develop a description of the Hawke's Bay regional economy, based on Statistics NZ employment and population data, and supplemented with available data on agricultural production. Using this data a generic regional input-output model for 2006-07 was created, using as a base a 2006-07 national input output model[31].

MRBL developed dryland and irrigated farm budgets for a range of different land uses, including for partially irrigated farms, and also for unirrigated farms which would change their land use to support the irrigated farms. For example, a farm which is currently dryland sheep and beef might convert to dryland dairy support, providing either feed or on-farm grazing to adjacent irrigated dairy farmers. These budgets were translated into a standard analytical format, and the budget components assigned to industry category and location of purchases (in and out of region)[32]. The location was determined on the basis of a survey of farmer expenditure patterns (see Appendix I). The model budgets for each land use were then incorporated into the generic Hawke's Bay input output table to produce a land use-specific regional model that is able to predict the likely regional impacts of land use changes in the irrigated area and adjacent land.

MRBL estimated that about 37 per cent of the land to be irrigated would be used for dairying, 20 per cent for other grazing (sheep and beef, finishing, and dairy support), 32 per cent for mixed use, cropping and vegetables, 5 per cent for orchards and 7 per cent for viticulture. This land use mix was then fed into the model to provide estimates of the economic impact from the Scheme.

3.3 Farmer Affordability Analysis

Affordability analysis has been undertaken by MRBL. Capital and operating budgets were developed for each farm type, with the latter showing operating cash surpluses after deducting all operating costs including costs of farm management (drawings in the case of an owner-operator), irrigation operating costs on farm[33], payment for water delivery by the new irrigation Scheme at a central price of $0.20 c / m3, and true economic depreciation[34].

Irrigated farm land was formerly under a dryland use, and the difference in capital costs / Ha under each land use was calculated (e.g. the difference between capital investment on a

---

30 Value Added is the return to labour and capital. As such it includes interest payments and taxes, which are payments made to owners of capital and to government from the income earned. In accounting terms, value added is equivalent to EBITDA plus wages and salaries. The analysis here deducts economic depreciation as a cost, and leads to value added being $6 million less per year than it would be using a more conventional definition of value added.

31 Based on the 2006-07 Supply – Use tables recently released by Statistics New Zealand.

32 The higher the proportion of expenditure which occurs out of the region, the lower the multiplier effects

33 There appears to be an implicit assumption that operating costs of the schemes will average $100 / Ha. This may be optimistic, but not unreasonable in the context of a scheme of which a significant part is piped.

34 Economic depreciation is the actual loss of asset value, which will have to be reinvested in the long term to maintain a viable operation. Economic depreciation is in contrast to depreciation for tax purposes, which often has a more tenuous link to economic realities.

dryland finishing farm and an irrigated dairy farm). The difference in annual cash operating surpluses returns / Ha at full production for the two land uses was divided by the difference in capital costs / Ha to estimate the marginal return on capital from conversion to irrigation. While this Accounting Rate of Return (ARR) at full development does not take into account the time delays in developing farms and getting them to full production (as would an IRR or NPV analysis), MRBL believes that the ARR is the basis of farmer decision making. The IRR will invariably be lower than the ARR.

The farmer affordability analysis gives some confidence that farmers will take up the water, and hence that the benefits and economic impacts proposed in this report will be realised.

4. Net Present Values and Economic Impact Assumptions

4.1 Land Use and Farm budgets

A mix of current and future land uses (see Table 1) was assumed on the basis of information obtained by MRBL. Farm budgets for each land type for the Ruataniwha area are based on MRBL's experience and on surveys of farm budgets in the Ruataniwha area. MRBL assumed irrigation reliability exceeding 95 %[35]. Farm models use MRBL predictions of long term average input costs and product prices[36].

The budgets show a surplus which is available to the newly irrigated farms to cover the capital costs of conversion and their share of water storage and distribution costs. The difference in cash operating surpluses prior to the irrigation Scheme and the cash operating surpluses after the establishment of the irrigation Scheme are the net financial benefits of the Scheme. Detailed farm budgets and differences in total costs are shown below in Table 2 and Table 3.

Table 1 Land Uses Before and After Irrigation (Ha)

	Sheep & Beef	Finishing & Dairy Support	Mixed & Arable	Dairy	Orchards	Viti-culture	Total*
Pre-Scheme	19,900 47 %	9,128 22 %	8,100 19 %	4,167 10 %	700 2 %	0 0 %	42,000 100 %
Post-Scheme - Total	18,850** 45 %	1,800 4 %	9,355** 22 %	9,175 22 %	1,130 3 %	1,695 4 %	42,000 100 %
Post-Scheme - irrigated	3,150 13 %	1,800 7 %	8,050 32 %	9,175 37 %	1,130 5 %	1,695 7 %	25,000 100 %

* Includes the entire area directly or indirectly affected by irrigation, even if it is not directly irrigated.
** Only partially irrigated

4.2 Irrigation Scheme and Farm Conversion Capital Costs

Capital Costs are based on information from HBRIC Ltd[37] and MRBL. The cost of storage and distribution including professional fees, the proposed power station, and mitigation works, is estimated to be $246[38] million. The costs of on-farm development are estimated at $247 million, with a further $109 million required for Fonterra shares and farm working capital. The total capital cost is thus $602 million.

Typical costs per Ha for conversion to irrigation are shown in Table 4 and Table 5. The additional investment in the Scheme and on-farm are the net financial costs of the Scheme. When appropriately discounted, the benefits less the costs give the net present value of the Scheme. MRBL notes that the total on-farm capital investment prior to irrigation was $890 million, and the total on-farm investment post-irrigation was $1,260 million, indicating

35 MRBL 2012. Section 6.1
36 The objective is to ensure that prices are not distorted by a current aberration from long term international price and exchange rate averages.
37 Based on information from Tonkin and Taylor.
38 Includes $7 million of mitigation costs over Scheme lifetime

additional investment of $370 million. Adjusting for some non-resource costs such as an assumed increase in land values reduced the additional on-farm investment to $356 million.

Table 2 Farm Income and Expenditure before Irrigation

	Sheep & Beef	Finishing	Arable & mixed	Dairy	Orchard	Total
Area (Ha)	19,905	9,128	8,100	4,167	700	**42,000**
Revenue	$000	$000	$000	$000	$000	$m
Sheep	13,735	6,785	16,200	-	-	36.7
Wool;	3,274	122	864	-	-	4.3
Cattle	13,110	20,994	6,974	1,609	-	42.7
Milk	-	-	-	33,219	-	33.2
All Other	-	852	6,534	-	40,040	47.4
less Stock Purchase	- 8,196	- 17,252	- 14,175	- 396	-	- 40.0
Total Revenue	**21,923**	**11,501**	**16,397**	**34,432**	**40,040**	**124**
Expenses						
Wages & Shearing	5,274	1,947	3,429	4,618	2,380	18
Animal Health	730	152	189	1,146	-	2
Stock feed	-	-	-	7,177	-	7
Other Stock Exp	-	-	54	472	-	1
Harvest, prune etc	-	-	-	-	7,609	8
Contracting	506	913	1,215	-	56	3
Freight, packing Coolstores	875	365	429	213	15,806	18
Fertiliser	1,721	822	1,728	1,806	280	6
Seeds etc	245	134	729	181	-	1
Weed & Pest	179	122	324	83	1,890	3
R & M	616	304	567	1,320	630	3
Vehicles	657	487	648	833	840	3
Electricity	206	152	1,215	1,223	140	3
Other working	152	91	27	-	280	1
Administration	349	304	238	250	784	2
Standing Charges	636	487	794	854	483	3
Cash Expenses	**12,144**	**6,280**	**11,586**	**20,176**	**31,178**	**81**
Economic Depreciation	1,265	761	1,323	1,007	1,120	5
Net Earnings	**8,514**	**4,461**	**3,488**	**13,250**	**7,742**	**37**
Jobs (FTEs)	**70**	**34**	**54**	**92**	**311**	**560**

Table 3 **Farm Income and Expenditure after Irrigation**

	Sheep & Beef	Finishing	Arable & mixed	Dairy	Orchard	Vineyard	Total	Difference From Dryland
Area (Ha)	18,846	1,800	9,355	9,175	1,130	1,695	**42,001**	**-**
Revenue	$000	$000	$000	$000	$000	$m	**$m**	**$m**
Sheep	22,812	3,636	13,393	-	-	-	**40**	**3**
Wool;	2,876	30	340	-	-	-	**3**	**- 1**
Cattle	9,623	3,522	-	4,129	-	-	**17**	**- 25**
Milk	-	-	-	97,868	-	-	**98**	**65**
All Other	5,683	462	51,019	-	64,636	28,872	**151**	**103**
less Stock Purchase	- 10,032	- 3,612	- 10,314	- 799	-	-	**- 25**	**15**
Total Revenue	**30,962**	**4,038**	**54,438**	**101,197**	**64,636**	**28,872**	**284**	**160**
Expenses								**-**
Wages & Shearing	5,015	626	4,346	12,237	3,842	4,746	**31**	**13**
Animal Health	621	68	244	3,521	-	-	**4**	**2**
Stock feed	-	-	-	20,950	-	-	**21**	**14**
Other Stock Exp	-	-	-	1,273	-	-	**1**	**1**
Harvest, prune etc	-	-	-	-	12,283	6,667	**19**	**11**
Contracting	1,332	329	5,203	650	90	1,384	**9**	**6**
Freight, packing								
Coolstores	699	78	2,416	329	25,515	-	**29**	**11**
Fertiliser	2,434	276	4,995	4,307	452	283	**13**	**6**
Seeds etc	360	53	4,837	780	-	-	**6**	**5**
Weed & Pest	266	39	4,395	184	3,051	1,243	**9**	**7**
R & M	581	60	1,216	3,211	1,017	565	**7**	**3**
Vehicles	753	96	1,370	2,171	1,356	706	**6**	**3**
Electricity	421	162	693	1,885	226	226	**4**	**1**
Other working	141	18	249	23	452	170	**1**	**1**
Administration	313	60	404	545	1,266	718	**3**	**1**
Standing Charges	3,116	1,548	6,835	11,133	1,345	1,243	**25**	**22**
Cash Expenses	**16,053**	**3,413**	**37,203**	**63,198**	**50,895**	**17,950**	**189**	**107**
Economic Depreciation	1,413	150	3,251	2,630	1,808	2,712	**12**	**6**
Net Earnings	**13,496**	**475**	**13,984**	**35,369**	**11,933**	**8,209**	**83**	**46**
Jobs (FTEs)	**67**	**9**	**70**	**233**	**502**	**312**	**1,193**	**632**

Table 4 Capital Costs / Ha and Total for each Land Use – Pre Storage

	Sheep & Beef	Sheep & Beef	Finishing	Mixed	Arable	Dairy – Heavy Land	Dairy – Light Land	Orchard	Vineyard	**Total Cost ($m)**
Land & Buildings	9,000	16,000	17,000		17,000	20,000	17,000	20,000		599
Irrigation Water Supply					150		338	800		3
On-farm Development					1,423		3,188	9,600		29
Assoc. Irrigation					183		413			3
Land-use specific					133	5,617	5,617	49,200		59
Plant & Equipment	556	833	833		1,333	1,667	2,567	9,000		47
Livestock	1,394	1,394	1,780		1,600	4,825	5,975			81
Fonterra Shares						3,865	5,749			23
Working Capital	335	381	409		763	1,284	1,474	33,416		46
Total per ha	**11,285**	**18,608**	**20,023**		**22,586**	**37,257**	**42,319**	**122,016**		
Irrigated Ha	**14,175**	**5,730**	**9,128**		**8,100**	**700**	**3,467**	**700**		
Total Capital Cost ($m)	**160**	**106**	**183**		**183**	**26**	**147**	**88**		**890**

Table 5 Capital Costs / Ha and Total for each Land Use – Post Storage

	Sheep & Beef	Sheep & Beef &DS	Finishing	Mixed	Arable	Dairy – Heavy Land	Dairy – Light Land	Orchard	Vineyard	**Total Cost**	**Additional Cost**
Land & Buildings	9,000	16,000	17,000	17,000	17,000	20,000	17,000	20,000	20,000	608	0*
On-farm Development	949		2,847	3,416	3,843	4,249	4,270	13,700	9,600	124	92
Assoc. Irrigation	222		776	944	650	698	723	166	159	19	12*
Land-use specific	391		400	480	360	5,617	5,617	49,200	33,500	170	111
Plant & Equipment	389	833	833	1,333	2,667	2,867	2,867	9,000	7,000	79	32
Livestock	1,394	648	1,318		1,262	6,713	7,079			97	16
Fonterra Shares						6,929	7,354			67	49
Working Capital	386	545	644	1,156	2,352	1,816	1,858	33,416	7,838	95	4
Total per ha	**12,731**	**18,026**	**23,818**	**24,330**	**28,134**	**48,888**	**46,768**	**125,482**	**78,097**		
Ha	14,175	4,671	1800	3688	5,667	1,150	8,025	1,130	1,695		
Total Capital Cost ($m)	**177**	**84**	**43**	**90**	**159**	**56**	**375**	**142**	**132**	**1,259**	**356**
				previously finishing		From unirrig dairy. But 30% was previously arable	From part-irrig dairy. But 60% was previously finishing	Previously finishing. Assume no change in land resource cost	Previously finishing. Assume no change in land resource cost		
Marginal Cost of Conv**	**1,225**	**-582**	**3,795**	**4,307**	**5,548**	**11,631**	**4,449**	**102,460**	**55,075**		

* Difference in total cost is not all a resource cost

** Note that this includes the off-farm costs

5. Summary of Net Present Value and Economic Impacts

5.1 Cost Benefit Analysis - NPV

The Cost Benefit Analysis suggests that development of the Scheme has a commercial Net Present Value of $7 million at an 8 per cent discount rate (see Table 6), and $225 million at a 5 per cent discount rate. That result assumes zero residual value of all assets after 35[39] years, and that all water will be taken up within eight years of water first becoming available. Sensitivity testing (below) considers the extension of the Scheme life to 70 and 100 years.

This NPV is equivalent to a 35 year stream of annual benefits of $0.6 million per year at an 8 per cent discount rate, or $14 million per year at a 5 per cent discount rate. It is helpful to look at annual benefits as well as NPVs given that the benefits could continue if the water rights extend beyond 35 years. Moreover, expressing benefits on an annual basis enables an easier and more meaningful comparison of the commercial outcome with net environmental, social and recreational costs and benefits which damming and irrigation may lead to.

Table 6 Net Present Value of Scheme over 35 year life time

Year	Capital Off-farm	Capital on Farm	% of Land Irrigated	Net Increase in Farm Income	Generation less Scheme OPEX	Net Annual Benefit ($m)
0	-60	0	0	0	0	-60
1	-60	0	0	0	0	-60
2	-60	0	0	0	0	-60
3	-65	-199	0	0	0	-264
4	0	-32	56	27	-0.6	-6
5	0	-18	65	33	-0.6	15
6	0	-11	70	39	-0.6	28
7	0	-11	73	43	-0.6	32
8	0	-14	76	46	-0.6	31
9	0	-4	80	48	-0.6	44
10	0	-68	81	50	-0.6	19
11	0	0	100	60	-0.6	59
12	0	0	100	61	-0.6	61
13	0	0	100	64	-0.6	62
14	0	0	100	64	-0.6	63
15	0	0	100	64	-0.6	63
16	0	0	100	64	-0.6	64
17	0	0	100	65	-0.6	64
18	0	0	100	65	-0.6	64
19 – 35	0	0	100	65	-0.6	64
Value undiscounted	246	356		1.900	-20	1,275
NPV (8 %)	-203	-229		+ 444	**5**	**7**
(5 %)	-217	-268		+719	**8**	**225**

- All cash flows assumed to be at end of year.
- IRR = 8.1 %

[39] A water right is assumed to be for 35 years.

Sensitivity Testing
Using a discount rate of 5 % increases the NPV to $225 million, and the equivalent return per year to $14 million, demonstrating the sensitivity to discount rates of projects with long gestation periods and life-times. Increasing the Scheme lifetime to 70 years, which seems a highly likely outcome, increases the NPV to between $54 million (8 % discount rate) and $408 million (5 % discount rate) as shown in Table 7. Extension of the Scheme life to 100 years increases the value still further.

Table 7 Scheme NPV ($m) under Varying Lifetime and Discount Rates

Scheme Life	8 % discount rate		5 % discount rate	
	NPV ($m)	Equivalent Annual Value ($m/yr)	NPV ($m)	Equivalent Annual Value ($m/yr)
35 years	7	0.6	225	14
70 years	54	4.5	408	21
100 years	57	4.6	439	22

Under the current base assumptions including an 8 % discount rate, the Scheme Net Benefit is small and an increase of only 3.5 % in storage and distribution costs would reduce the NPV to zero. However, at a 5 % discount rate the NPV would remain positive even if storage and distribution costs doubled.

Increasing the amount of land which goes into orchard and vineyard development actually reduces the NPV, and decreasing the amount would increase the NPV at 8 %. This is because the accounting rates of return to these two land uses straddle the discount rate (9.4 % and 7.1 % respectively) and their IRR is less than the discount rate.

5.2 Economic Impacts in Hawke's Bay of Increased Production

5.2.1 Direct Impacts

The irrigation of 19,000 Ha of dryland and improved irrigation reliability on the 6,000 Ha which is already irrigated[40] will eventually increase farm-gate income by an estimated $160 million / year[41]. Expenses, including real economic depreciation of $6 million and wages, salaries, and drawings of $25 million, will increase by $107 million per year, while profits (before interest and tax, but after charges for water delivery to the gate) will increase by $46 million per year. Hence value added[42] will increase by $70 million per year. Associated with this additional activity are an additional 630 jobs on farm.

[40] 2,700 Ha of arable, 2,600 Ha of dairying on light soils, and 700 Ha of orchards.
[41] Source is MRBL 2012 report, Appendix 5.
[42] $25 million household income and $46 million profit = $70 million. Difference is due to rounding. Depreciation has been treated as an averaged on-going farm expense for the purposes of estimating economic impacts.

Table 8 Direct Net Economic Impacts from irrigating 25,000 Ha via the Ruataniwha Scheme.

	Irrigated *less* Dryland				
	Additional Ha	Sales ($m / yr)	Jobs (FTEs)	Value Added* ($m / yr)	Household Income* ($m yr)
Sheep & Beef	-1,059	9.1	-3	-4.7	-0.2
Finishing & Dairy Support	-7,330	-7.5	-24	-5.3	-1.3
Mixed	+3,688	12.7	25	6.0	1.5
Arable & Vegetables	-2,433	+25.3	-8	7.7	-0.6
Dairy	5,008	66.8	140	29.7	7.6
Orchards	430	24.6	190	10.3	6.1
Vineyards	1,695	28.9	310	19.2	11.1
Total	0	160	630	70	24

* Output (or sales) less non-wage operating costs = Value added. It includes household income.

** Value Added is the return to labour and capital. Hence it includes household income as shown, as well as interest, depreciation and profits (before tax).

The scale of the economic impacts is highly dependent on the assumptions regarding orchards and vineyards, with 33 % of the additional output, 42 % of the value added, 72 % of the additional household income and 80 %[43] of the additional employment depending on the conversion to orchards and vineyards. The huge increases in household income and employment arise from the very high labour demands for pruning, thinning and picking.

5.2.2 Total Impacts

There are significant multiplier effects arising from the provision of goods and services to support increased farm production and household spending. These impacts raise the total impacts in the region to 1,160 jobs and $127 million of value added, including $52 million / year of household income. This excludes any effects on processing of output.

There is considerable uncertainty related to all forms of processing. Milk processing is likely to be done outside the region as is almost half[44] of meat processing. The value of stock going to slaughter in the region is likely to decline by perhaps $7 million per year as sheep and beef give way to dairying, dairy support, orchards, and vineyards. Vegetable processing and wine-making could generate very significant household income and employment. If all additional vegetable and grape production and half of all additional dairy and meat production was processed in Hawke's Bay, then the total regional impact of the processing would be an additional $108 million per year of Value added (including $58 million per year of additional household income), and there would be an additional 1,090 jobs.

Combining farming, processing and all related supporting industries, the total regional economic impact would be an increase in value added (regional GDP) of $235 million per year, including an increase in regional household income of $110 million per year, and an additional 2,250 jobs.

[43] This calculation involves an approximation that pruning and picking costs are all labour, with an average cost of $16 / labour hour (including overheads), or $30,000 / FTE.

[44] Based on a survey of farmers in the irrigation area which suggests that they send 47 % of their stock to processing works outside the region.

Table 9 Total Hawke's Bay Net Economic Impacts from irrigating 25,000 Ha.

	Output ($m / yr)	Jobs (FTEs)	Value Added ($m / yr)	Hhold Income ($m/yr)
Pastoral and arable farming direct	107	130	40	8
Orchards and Vineyards (or similar)	53	500	30	17
Farm support effects (multiplier effects)	120	530	56	27
Sub-Total – Farming-dependent	***280***	***1,160***	***127***	***52***
Processing including multiplier effects				
Vegetables	145	525	52	29
Wine	129	480	46	26
Meat	-10	-30	-4	-2
Dairy	76	110	14	7
Sub-total (high uncertainty)	***340***	***1,090***	***108***	***58***
Potential Total Impacts* **	**620**	**2,250**	**235**	**110**

* Output (or sales) less non-wage operating costs = Value added.

** Value Added is the return to labour and capital. Hence it includes household income as shown, as well as interest, non-economic depreciation and profits (before tax).

5.2.3 Impacts in Context

The increases in activity associated with the Scheme would represent increases of approximately 4 per cent in 2006-07[45] Hawke's Bay regional GDP and 3.5 per cent in district employment (see Table 10). The jobs that are derived through irrigation are effectively embedded in the regional economy – they cannot be outsourced overseas or moved to other parts of New Zealand. The Scheme therefore provides a significant return on the use of regional resources if increased employment and economic activity is a policy goal.

Table 10 Scheme-dependent Impacts as % of Hawke's Bay Economic Activity

	Value added			**Employment (FTEs)**		
	Region ($m / yr) 2006-07	Scheme Change ($m/yr)	Change compared to base (%)	Region (FTEs) 2006-07	Scheme Change (FTEs)	Change compared to base (%)
All agriculture	490	70	14 %	9,310	630	7 %
All other sectors (incl. processing)	5,300	160	3.0 %	54,670	1,620	3 %
Total economy	5,789	230	4.0 %	63,980	2,250	3.5 %

5.3 Distribution of Income and Employment across Sectors

About two thirds of the on-going economic impacts (excluding processing) occur within agriculture (see Table 11), with other significant impacts occurring in rural contracting, wholesale and retail trade, transport and storage (including packhouses and coolstores), and services, including vet services, repair services and local government, which is expected to get an additional $2.4 million in year in rates income.

[45] This the latest year for which a regional I-O table is available. Growth since then means that the effects of the scheme as a percentage of the current Hawke's Bay economy will probably be marginally lower.

The implication is that off-farm economic impacts are widely dispersed, and people in many industries get a benefit[46] from irrigation and the resultant increase in farming activity. This conclusion will be greatly strengthened if the very considerable potential impacts of processing are realised.

Table 11 Distribution of Net Total Farm and Farm Support Economic Impacts among Sectors in Hawke's Bay

Sector	Employment		Household Income		Value Added	
	FTEs	%	$m/yr	%	$m/yr	%
Agriculture	630	54	25	47	70	56
Rural Contracting	81	7	3.1	6	4	3
Other Primary Industry	5	0	0.2	0	1	0
All other Manufacturing	34	3	2.0	4	4	3
Utilities* & Construction	49	4	3.8	7	14	11
Wholesale and Retail Trade	123	11	5.5	10	8	7
Transport** & Communications	75	6	3.8	7	6	5
Other Services	163	14	9.4	18	18	15
Total Net Impacts	1,160	100	52	100	127	100

Numbers may not add due to rounding
Source: Calculations of disaggregated multipliers from district input output model
* Includes maintenance of Scheme
** Includes fruit packhouses and coolstores, but not any other processing

5.4 Economic Impacts of Increased Investment

The increased investment of $602 million in storage and distribution structures and on-farm investment could lead to an additional one-off total increase in regional output of $1,100 million[47] over a 12 year period. Associated with this is an increase in value added of $350 million, including household income of $230 million, and an additional 4,000 job-years of work. This economic impact will be focussed on the first four years, when all the dam construction and the first 50 per cent of on farm investment are assumed to take place. The balance will be spread over the remaining 10 years of the investment programme until land development is completed.

Table 12 Regional Economic Impacts of Ruataniwha Scheme – Construction-related Only (One-off Effects spread over 12 years)

	Output ($m)	Jobs (job-years)	Value Added ($m)	Hhold Income ($m)
Direct Impacts	602	na	na	na
Total Impacts	1,100	4,000	350	230

[46] Assuming they are not capacity constrained, and do not have to turn down other work in order to meet the needs of irrigated farming.

[47] For the purposes of this exercise, spending on Fonterra shares and working capital is included as a change in output but has no effect on value added or employment.

5.5 Revenue Impacts of Increased activity at Port of Napier

The increase in farming production and processed product is expected to go almost entirely to export. This will increase shipping through the Port of Napier, and will significantly increase port revenue, and hence profits and council dividends. An additional 8,000 containers of export cargo and possibly 1,000 containers of inward cargo are expected (see Table 13). If port earnings (EBIT) at the margin are of the order of $150 per container[48], the increased traffic could increase EBIT by $1.3 million / year.

Meat

Meat production will decline by perhaps $14 million per year f.o.b. If we take the average price as $14 / kg f.o.b. then the reduction will be 1million kg or 1,000 tonnes. At 24 tonnes / 40 foot container that will be 42 fewer containers, or 84 fewer TEU (twenty foot equivalent units) per year.

Apples

Production increases by 923,000 cartons per year. There are 1175 cartons per 40 foot container so an extra 785 containers or 1,530 TEUs per year could be shipped.

Dairy

Dairy output could be an additional 9.6 million kg milkfat and maybe 10,000 tonnes of product (depending on what is produced). Possibly a significant amount will go through Napier even it if is processed in Hawera (this depends a lot on shipping schedules and shipping line decisions). There are 17 tonnes of dairy per 20 per container, so the increase is 590 containers or 590 TEUs / year.

Processed vegetables

Increased production of peas, beans, potatoes and squash is tentatively estimated to be 61,000 tonnes / year. If we assume 50,000 tonnes of shipped weight and 23 tonnes of processed vegetables per 40' container, this is and additional 2,200 containers, or 4,400 TEUs / yr

Wine:

1 tonne of grapes produces about 750 litres of wine, which is equivalent to 1,000 bottles or 83 cartons of wine. The expected production increase is 10 tonnes / Ha of grapes x 1,695 Ha, or 16,950 tonnes and 1,400,000 cartons. At 700 cartons per 20' container this is 2,000 containers or 2,000 TEUs / year.

Inwards Freight

Growth in the regional economy would also increase inwards general freight and port revenue. Given that the economic impact has been estimated at around 4 % of Napier's GDP, and allowing for the fact that the port of Napier services more than just the Hawke's Bay region, inwards cargo might grow by perhaps 2 per cent.

[48] According to the Port of Napier 2011 annual report, EBIT was $19 million and traffic was 188,000 containers. Some of the earnings would come from bulk traffic, but a very rough approximation is that average EBIT is $80 / container. At the margin, one would expect significantly higher earnings per container, a point which was alluded to by the chairman who, in talking about the rapid increased in profit in the preceding year said that this "highlighted the impact of increased volumes through fixed infrastructure".

Table 13 Expected increases in Container Traffic.

Product	Containers (TEUs) per year	Inward cargo (2 % growth)
Meat	-84	Assumed to total 50,000 containers per year
Apples	1,530	
Dairy	590	
Vegetables	4,400	
Wine	2,000	
Total	8,436	1,000

6. Interpreting the Results

6.1 Expected Outcomes

Economic Impact Assessment

Regional GDP will increase by a one-off $350 million as a result of both on-farm and off-farm investment associated with the on-farm development and construction phases of the Scheme. Associated with that will be an extra $230 million of household income and 4,000 job-years of work. These impacts will be spread over 12 years, but 80 per cent will occur in the first five years.

Regional GDP will increase as farms convert to irrigation, and once the full 25,000 Ha is being irrigated, regional GDP on farms and in industries that directly or indirectly support farms will increase by $127 million per year. Associated with this increase will be an additional $52 million per year of household income and 1,160 Full Time Equivalent jobs.

There will be an increase in processing of vegetables, grapes, other fruit and possibly dairy. There will be a decline in meat processing with the conversion of so much sheep and beef to dairying, dairy support and intensive process crops. While there is considerable uncertainty about the level of processing that will occur in the region, the increase in processing could increase regional GDP by $108 million per year. Associated with this would be an increase of $58 million per year in household income and 1,090 jobs.

The total combined increase in activity in the farming, processing and supporting industries could raise regional GDP by approximately $235 million per year including an additional $110 million per year in household income. A total of 2,250 extra on-going jobs will be created in the region

Economic Benefits- Cost Benefit Analysis

There will be a net economic benefit to farmers (at the assumed water charges) equivalent to $46 million per year once the Scheme is fully implemented, and a benefit to the Scheme of $19 million per year in water charges. However, this additional income has to be used to cover the Scheme operating costs and the up-front capital and interest of on-farm and off-farm investment. Depending on the real interest rate and the life time of the Scheme, farmers and the irrigation supplier together will be better off over the entire Scheme life by the equivalent of between $0.6 million and $21 million per year, which have Net Present Values (NPV) of $7 million and $408 million respectively. This NPV benefit might be termed the "super profit", which is the profit over and above the normal returns to labour and capital invested in the Scheme. The huge variation in benefits reflects the significance of the choice of Scheme lifetime and interest rate assumptions, particularly in long-lived projects. It is our view that the $7 million NPV figure is useful only inasmuch as it can be used by Treasury to provide a funding priority ranking for this Scheme against other infrastructure projects with similar lifetimes and project assumptions. We believe that from a community and farmer perspective the figures of $14 million per year and a NPV of $408 million are more relevant.

The wider community is also expected to benefit from the increase in household income and employment discussed above, but the scale of this benefit depends on the ways in which labour and capital would have been employed in the absence of the Scheme. If the Scheme displaces other projects which are just as good as the Scheme, then there is no particular benefit from the Scheme because net employment and income will not have increased. It will simply have been switched between industries. It is our view that this Scheme will significantly increase regional income and employment above what it would otherwise be, but we note that not everyone shares this view. There is no agreed factor to convert impacts to benefits.

We can not say whether the Scheme will have a net benefit from the widest societal perspective, which takes into account environmental and other non-market values such as recreation which are affected by the state of the river and levels of water abstraction. That widest perspective is a matter beyond the scope of economics. What we have done is provide decision makers with information to inform their weighing up of the wide range of costs and benefits.

Councils in Hawke's Bay will benefit by an estimated $2.4 million per year increase in rates, although this is not a pure benefit since they will also have to pay for an increased range of services as a result of the increase in population and economic activity generally. Councils are also likely to enjoy an increase in returns from the Port which could be of the order of $1.3 million per year. Councils may use their net increase in income to either increase the range of services they provide to the community, or reduce the average rate burden for all ratepayers.

The benefit on farms will be derived from a number of sources:
On the irrigated area:

- An increase in production associated with irrigation of existing systems;
- A change in systems to higher intensity land uses such as dairying and cropping which are possible with more reliable irrigation;
- Reduced farming risk, which increases returns by enabling famers to move towards more risk-neutral behaviour which generally has a higher average return than does a risk-averse management style.

On associated dry land:

- Ability to manage associated dryland areas better, given the increased flexibility which irrigation usually generates. This latter benefit has not been estimated for this Scheme

6.2 Uncertainty of Outcomes

As is to be expected at this stage of project development, there remains uncertainty as to the final capital costs of construction, the scale of environmental effects after mitigation measures, and the economic impacts. These depend heavily on the actual land uses which come to pass, and on the degree and location of processing of the farm output. Nonetheless, these results present a realistic picture of potential economic impacts, and the farm-related impacts are consistent with the impacts which have been observed in previous studies which compare irrigated land with adjacent un-irrigated land.

The greatest uncertainty with respect to economic impacts relates to the proportion of land which goes into orchards and vineyards, and the level of processing of vegetables, dairy and

grapes which takes place in the region. Even though the analysis assumes that only 11 % of the irrigated land goes into orchards and vineyards, these account for 80 % of the direct on-arm employment increase, 70 % of the direct household income increase and 40 % of the direct value added increase. While the MRBL report anticipates that these land uses will be profitable at long run product prices, these prices are well above current prices, and it may be some time before investment in these sectors takes off.

References

Butcher Partners Ltd and Agribusiness Group. *Irrigation Water in Ashburton District: The Economic Value of Water at the Farm Gate*. 2012.

Macfarlane Rural Business Ltd, Baker and Associates, and AgFirst. *Feasibility Study of on-farm Economics for proposed Ruataniwha Irrigation Scheme*. For Hawke's Bay Regional Council. 14th May 2011.

Macfarlane Rural Business Ltd, Baker and Associates, and AgFirst. *Ruataniwha Water Storage Project: Review of Farm Profitability*. For Hawke's Bay Regional Council. 5th September 2012.

New Zealand Institute of Economic Research. *Economics Like There's No Tomorrow*. Insight 32/2011, November 2011

Tonkin and Taylor. *Ruataniwha Plains Water Augmentation Scheme: Feasibility Project Description –Summary Report.* Prepared for Hawke's Bay Regional Council; Feb 2011.

Tonkin and Taylor. *Ruataniwha Plains Water Storage Project: Advance Prefeasibility Study* Prepared for Hawke's Bay Regional Council; August 2012.

Tonkin and Taylor. *Ruataniwha Water Storage Scheme: Project Description.* Prepared for Hawke's Bay Regional Investment Company Limited; May 2013

Appendix I Survey of Farmer Expenditure Patterns

For the purposes of this work we undertook a survey of farmers in the irrigable area, asking them about where they purchased various inputs from, where their output went to be processed, and what their current and intended land uses were on whatever irrigable land that they had. This appendix contains the survey letter and form sent out to about 150 households. We received 63 usable responses. The response rate of more than 40 per cent is generally regarded as good for a postal survey. Nonetheless there is a significant margin of error as regards intended land use because some of the largest land owners did not respond.

The average responses have been inserted into the survey form on the next pages.

Hawke's Bay Regional Council
159 Dalton Street
Private Bag 6006
Napier, New Zealand
Tel 06 835 9200
Fax 06 835 3601
Freephone 0800 108 838
www.hbrc.govt.nz

10 June 2011

Dear Landowner

Ruataniwha Storage/Irrigation Project Survey – URGENT RESPONSE REQUESTED

Last month, the Government announced the establishment of an Irrigation Acceleration Fund. This provides $35 million over 5 years to unlock the economic growth potential of our primary sectors by developing more efficient and effective water infrastructure, such as storage and distribution.

Hawke's Bay Regional Council has, on behalf of the community, embarked on an investigation of the feasibility of a storage/irrigation scheme in the Ruataniwha area, and this is progressing well. We recently completed an on-farm economic assessment of the proposed scheme and the initial results look promising. In the circumstances, we consider that we are well placed to take advantage of the Government funding.

We are now surveying landowners in the Ruataniwha area to gain data to help determine how the possible addition of an irrigation scheme and the resulting increased farm productive output will benefit/impact the whole region. The survey asks for an indication of the location where you buy your various farm inputs, details of your current/anticipated land use and where your product is processed.

Your participation would be greatly appreciated. Your input will enable us to estimate regional impacts/benefits more accurately and thereby assist in presenting a more compelling case for Government funding of the storage project. While it may not be easy to predict exactly the answers to all questions, your best estimate will be extremely useful. We expect that the survey will take approximately 10 minutes to complete.

Please return your completed survey questionnaire, in the freepost envelope provided, by Thursday 23 June 2011. If you have any questions, please contact Grant Pechey, Economic and Legal Advisor, grant@hbrc.govt.nz or 0800 108 838.
Yours sincerely

GRAEME HANSEN
Group Manager – Water Initiatives
WATER INITIATIVES GROUP
Phone: (06) 835 9204, Mobile: 0274 555 213
Email: ganz@hbrc.govt.nz

Survey of Where You Currently Spend your Money, and Where Your Product is processed.

1. For each expenditure category, please estimate approximately what proportion of the expenditure takes place within Ruataniwha District, Elsewhere in Hawke's Bay and Outside Hawke's Bay, and fill in the table below. Obviously the total will be 100 % of that category. If you do not undertake expenditure in that category please put n.a. (not applicable),

	% in Ruataniwha District	% else-where in Hawke's Bay	% outside Hawke's Bay	**Total**
Livestock Purchases (including stud stock)	24	44		100 %
Wages	90	8		100 %
Animal health and vet	83	12		
- chemicals				100 %
- vet	89	9		100 %
Feed				
- Contractors	96	3		100 %
- Purchased off-farm	88	3		100 %
- Grazing	67	24		100 %
- Other	100	0		100 %
Fertiliser				
- Materials	71	25		100 %
- Freight	86	13		100 %
- Application	87	13		100 %
Lime				
- Materials	91	7		100 %
- Freight	93	5		100 %
- Application	93	7		100 %
Freight	87	10		100 %
Seeds	82	8		100 %
Shearing				
- Contract Shearers	74	25		100 %
- Shed	90	10		100 %
- Groceries & materials	89	11		100 %
Weed & Pest				
- Materials	76	15		100 %
- Application	90	10		100 %
Dairy Breeding (only 3 responses)				
- herd testing	0	0		100 %
- A.I.	75	0		100 %
- Materials	25	0		100 %
- Other	100	0		100 %
Dairy Shed Expenses				
- Chemicals	98	2		100 %
- Rubberware	40	0		100 %
- Other	0	0		100 %
-				

	% in Ruataniwha District	% else-where in Hawke's Bay	% outside Hawke's Bay	**Total**
Fuel	80	16		100 %
Vehicle R & M	79	18		100 %
General Farm R & M	85	14		100 %
Insurance agent	39	30		100 %
Accounting, legal, consultants	45	40		100 %
Drawings				
- Groceries	74	25		100 %
- Clothes	40	52		100 %
- Furnishings	35	58		100 %
- Schooling	49	48		100 %
- Entertainment	46	43		100 %
- Other (travel)	40	43		100 %
- Other (Please specify)				100 %
Purchases of major plant items	49	34		100 %

2. Where is your output processed?

	% in Ruataniwha District	% else-where in Hawke's Bay	% outside Hawke's Bay	Total
Meat to Works	21	32		100 %
Milk to Dairy Factory	0	0		100 %
Other (please specify)	-			

3. Changes to Where you Buy things from

Briefly describe any changes to the above percentages which you think might happen if the proposed irrigation project goes ahead. *Generally expect no change, although will spend more and some new items may not be available locally*

3. Irrigated Areas

Total Area of Farm	22,900
Area Currently irrigated	1,060
ADDITIONAL Area that can be irrigated.	9,900
ADDITIONAL Area that you wish to irrigate.	7,400

4. Irrigation Intentions

CURRENT Land use on area which you want to irrigate in future.		Sheep Beef, Deer 30 %; Dairy grazing 20 % Cropping 10 %; Mixed crop & grazing 24 %; Dairy 17 %
Proposed FUTURE Land use on area which you want to irrigate in future. *Responses are by % of area intended to be irrigated*		Arable 21 %, Mixed livestock & cropping 25 % Livestock 4 %; Dairying 29 %, horticulture <1% Dairy Support 18 %; Not sure 3 %
Or:		
No intention to irrigate.	(tick if appropriate)	6 (small properties or nothing irrigable
Not sure.	(tick if appropriate)	9 respondents (only 36 intended to be irrigated)
Sell and leave it up to the new owner.	(tick if appropriate)	1

Many thanks for your help. Please return in enclosed reply-paid envelope.

Appendix II. Glossary of Economic Terms

Employment
Employment is work done by employees and self-employed persons, and is measured in Full-Time-Equivalent jobs (FTEs). A person working part time all year is deemed to be equivalent to 0.5 FTEs. Where work is seasonal, the conversion to FTEs is based on 12 months work per year. So a seasonal worker working full time for six months per year is 0.5 FTEs, and a part time seasonal worker working ten hours per week for 4 months is 0.1 FTEs.

Output
Output is the value of sales by a business. In the case of wholesale and retail trade it is the total value of turnover (and not simply gross margins)[49].

Value Added
Value added includes household income (wages and salaries and self-employed income), and returns to capital (including interest, depreciation and profits). It also includes all taxes. Put another way, Value Added is equal to Output less costs other than wages, salaries, depreciation and interest. From an accounting perspective it is equivalent to EBITDA plus Wages & salaries.

Household Income
Household income is the gross earned income of households. It includes the income of self-employed persons. There is sometimes considerable uncertainty as to the proportion of business income, which goes to households, especially for small businesses. In assessing this proportion, dividends and interest payments have been excluded. When estimating indirect economic impacts, one needs to know the increase in household income, which occurs in the region.

Direct Economic Impacts
The direct impact is the output and employment of the business itself (in this case the farm). The direct employment is of people who work on the farm. The direct output is the value of farm gate sales. The direct value added is the value added on the farm. It is equivalent to operating surplus, before interest or tax, plus wages, salaries and drawings.

Indirect Economic Impacts
The indirect impact arises from increased spending by farms as they buy additional inputs so that they can increase production to meet plant demands. This indirect effect can be envisaged as an expanding ripple effect. For example, the farm buys fertiliser, the fertiliser factory has to employ more staff and buy more electricity, so the electricity industry expands. The electricity industry has to employ more staff and buy more fuel, so the fuel company increases its output. And so on. All the

[49] Care has to be taken in combining retail sales figures with employment per $million of output from input-output tables. In these tables, output is generally defined as gross margin. By contrast, business statistics usually refer to employment per $million of turnover.

increased employment, output and value added (apart from that at the farm) are the indirect effect.

Note that indirect effects only include "upstream" effects (via buying more inputs), but do not include any stimulated development downstream, such as processing vegetables.

Induced Economic Impact
The induced impact is the result of increased household income being spent, and leading to a further ripple effect of increased employment, output and income.

Flow on Effects / Upstream Impacts
The sum of indirect and induced effects is sometimes termed the flow on effects, or upstream impacts.

Down Stream Impacts
Impacts which are not driven by an activity's demand for extra inputs, but which might arise as a result of a particular activity, are sometimes called the "Downstream impacts". The obvious example in the farming industry is the processing sector, where there is whole new set of direct and flow on effects. These effects are not included in the initial farm impacts, which focus only on the supply of inputs.

Total Economic Impacts
The total Type I impact is the sum of the direct and indirect impacts, and a Type II impact is the sum of direct, indirect and induced impacts.

Multipliers
A Type I multiplier is the ratio of (direct + indirect) impacts to direct impacts, and a type II multiplier is the ratio of (direct + indirect + induced) impacts to direct impacts. The Type II multipliers include the impact of household spending and hence will always be greater than a Type I multiplier. Both multipliers will always be greater than 1. Note that downstream effects (whether positive or negative) are not included in the multiplier, and must be calculated separately.